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To Mr. D. Erwin
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Attn: Mr. J.H.P. Buckingham
Senior Supervisor
Ash Management

BOOTH QUARRY GROUND WATER MONITORING NOVEMBER, 1983

A. Golomb

A major decrease (first observed in November, 1982) persists in concentrations of dissolved components of ground water sampled from the central sump, where a shift in major ion chemistry has taken place. Water quality of samples taken from other observation wells at the ash disposal site has undergone little significant change. Piezometric head measurements reveal little significant change in the water table level. Monitoring continues.

Ground water samples were taken from the central sump and four peripheral monitoring wells at Booth Quarry ash disposal site, in the Borough of Etobicoke, on November 16, 1983. Analytical results are given in Table I. Sampling locations are shown in Figure 1. A Piper trilinear diagram for all locations (Figure 2) shows that ground waters taken from the central sump, OW-2-77 and OW-8-77 all lie in the region of dominance of alkaline earths and weak acid anions, while ground waters from OW-1-82 and OW-6-82 have no dominance of major ions.

Based on major ion balances (Tables II-VI) for the various sampling points, Piper trilinear diagrams (Figures 3-7) show that major ion chemistry has generally undergone little change since the previous sampling (June, 1983)/1/. Ground waters sampled from OW-2-77 and OW-8-77 remain practically unchanged. OW-1-82 water remains in a region of 'no dominance' of major ions, as does OW-6-82 water, which remains close to the major ion chemistry domain associated with that of the central sump up to and including the sampling of June 1982.

job	file	date	report no.
740631-110-892	837.71	March 22, 1984	84-25-K

Chemical characteristics of central sump water reflect continuation of a major (~20:1) dilution which occurred following the sampling of June, 1982, when concentrations of most components decreased to levels below those reported/2/ for Lake Ontario water. It was suggested earlier/3/ that the observed dilution might have resulted from infiltration of precipitation and runoff through the still uncovered fly ash fill surrounding the central sump. During 1983, the dilution of central sump water has been accompanied by a shift in major ion chemistry into the region of dominance of alkaline earths and weak acid anions. This change cannot be accounted for by simple dilution; it is hoped that the cause will be determined during the course of further monitoring.

The piezometric head survey for 1982-1983 (Table VII) shows little overall change in the water table. There has not been any apparent increase in the level of the central sump (or any of the downstream piezometers) that might be expected to accompany the major dilution observed. Monitoring continues.

Approved:

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Submitted:

A. Golomb
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AG:km

REFERENCES

1. Research Division Report No 83-332-K.

2. Ontario MOE, 1978. Unpublished data.

3. Research Division Report No 83-15-K.

TABLE I

CHARACTERISTICS OF GROUNDWATERS AT BOOTH QUARRY ASH DISPOSAL SITE
NOVEMBER 16, 1983

	Central Sump	OW-1-82	OW-2-77	OW-6-82	OW-8-77
pH	7.6	8.0	7.8	7.9	7.7
Sp Conductivity (mS/m)	19.5	118	92	143	74
Alkalinity OH^-	<5	<5	<5	<5	<5
as $CO_3^=$	<5	26	25	25	22
$CaCO_3$ HCO_3^-	54	285	299	348	239
Hardness (as $CaCO_3$)	71	271	524	574	406
Sulphate	24	150	150	330	100
Chloride	5.9	95	20	60	23
Sodium	3.0	160	35	106	31
Potassium	4.4	18	7.5	29	1.5
Calcium	24	74	136	155	138
Magnesium	2.6	21	45	48	15
Aluminum	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	0.001	<0.001	<0.001	<0.001	<0.001
Barium	<2	<2	<2	<2	<2
Boron	0.2	2.3	0.4	2.7	0.2
Cadmium	<0.0001	0.0001	0.0001	0.0001	0.0001
Chromium	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	<0.001	0.001	0.001	0.001	0.001
Iron	0.2	0.06	0.05	0.1	0.2
Lead	<0.002	<0.002	<0.002	<0.002	<0.002
Manganese	0.1	0.5	<0.05	0.4	0.16
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel	<0.005	<0.005	<0.005	<0.005	<0.005
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	0.06	1.51	0.89	4.4	0.39
Titanium	<1	<1	<1	<1	<1
Vanadium	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	<0.02	<0.02	<0.02	<0.02	<0.02
TDS	110	710	610	990	490

Note: All concentrations given in milligrams per litre.

TABLE 11

MAJOR ION CHEMISTRY
BOOTH QUARRY - CENTRAL SUMP

CATIONS

Date	Ca			Mg			Na			K			CATION TOTAL	ANION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	24	1.20	72	2.6	0.21	13	3.0	0.13	8	4.4	0.11	7	1.66	1.66
June 13, 1983	27	1.35	79	2.4	0.20	12	2.9	0.13	8	0.7	0.02	1	1.70	1.73
Nov 16, 1982	25	1.25	77	2.7	0.22	14	3.2	0.14	8	0.7	0.02	1	1.63	1.55
June 16, 1982	370	18.46	51	114	9.37	26	160	6.96	19	54	1.38	4	36.17	32.87
Oct 13, 1981	220	10.98	50	77	6.33	23	190	8.27	38	54	1.38	6	26.96	27.37
June 09, 1981	258	12.87	44	87	7.16	24	188	8.18	28	51	1.30	4	29.51	29.23
June 12, 1980	300	14.96	42	108	8.89	25	240	10.43	29	44	1.13	3	35.41	36.87
Nov 21, 1979	310	15.46	35	95	7.82	18	435	18.91	43	60	1.53	4	43.73	42.89
Sept 12, 1979	390	19.45	39	100	8.23	17	470	20.43	41	60	1.53	3	49.65	48.24
June 06, 1979	230	11.47	36	95	7.82	24	260	11.30	35	60	1.53	5	32.13	32.47
Sept 21, 1978	186	9.28	42	69	5.68	25	169	7.35	33	0	0	0	22.30	21.35
May 06, 1978	130	6.48	41	40	3.29	21	130	5.65	36	18	0.46	3	15.89	15.44
June 10, 1977	370	18.45	34	100	8.23	15	630	27.39	51	0	0	0	54.08	56.27

ANIONS

Date	Cl			SO_4			HCO_3			CO_3			ANION TOTAL	CATION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	3.0	0.08	5	24	0.50	30	54	1.08	65	0	0	0	1.66	1.66
June 13, 1983	5.0	0.14	8	30	0.63	36	48	0.96	56	0	0	0	1.73	1.70
Nov 16, 1982	4.8	0.14	9	30	0.63	41	39	0.78	50	0	0	0	1.55	1.63
June 16, 1982	160	4.51	14	970	20.18	61	375	7.50	23	34	0.68	2	32.87	36.17
Oct 13, 1981	160	4.51	16	800	16.66	61	378	6.20	23	0	0	0	27.37	26.96
June 09, 1981	166	4.68	16	850	17.00	61	418	6.85	23	0	0	0	29.23	29.51
June 12, 1980	310	8.73	24	1060	22.06	60	371	6.08	16	0	0	0	36.87	35.41
Nov 21, 1979	565	15.92	37	1060	22.06	51	300	4.92	11	0	0	0	42.89	43.73
Sept 12, 1979	840	23.66	49	960	19.98	41	281	4.60	10	0	0	0	48.24	49.65
June 06, 1979	300	8.45	26	770	16.02	49	488	8.00	25	0	0	0	32.47	32.13
Sept 21, 1978	213	6.00	28	308	6.41	30	545	8.94	42	0	0	0	21.35	22.30
May 06, 1978	150	4.23	27	270	5.62	36	342	5.60	36	0	0	0	15.44	15.89
June 10, 1977	1300	36.62	65	170	14.78	26	298	4.88	9	0	0	0	56.27	54.08

Note: EPM denotes equivalents per million

TABLE III

MAJOR ION CHEMISTRY
SOUTH QUARRY-OW-1-82

CATIONS

	Ca			Mg			Na			K				
Date	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	CATION TOTAL	ANION TOTAL
Nov 16, 1983	74	3.70	29	21	1.73	13	160	6.96	54	18	0.46	4	12.85	12.02
June 13, 1983	57	2.85	24	18	1.48	12	165	7.17	61	16	0.41	3	11.91	12.27
Nov 16, 1982	53	2.65	25	17	1.40	13	136	5.91	57	21	0.54	5	10.50	11.27
June 16, 1982	65	3.24	34	16	1.32	14	103	4.48	46	24	0.61	6	9.65	7.60
June 06, 1979	166	7.98	47	65	5.35	31	84	3.65	21	5	0.13	1	17.12	19.20
June 10, 1977	110	5.49	53	54	4.44	43	11	0.48	5	0	0	0	10.41	14.64

ANIONS

	Cl			SO_4			HCO_3			CO_3				
Date	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	ANION TOTAL	CATION TOTAL
Nov 16, 1983	95	2.68	22	150	3.13	26	285	5.70	47	26	0.52	4	12.02	12.85
June 13, 1983	93	2.62	21	180	3.75	31	295	5.90	48	0	0	0	12.27	11.91
Nov 16, 1982	63	1.77	16	170	3.54	31	274	5.48	49	24	0.48	4	11.27	10.50
June 16, 1982	42	1.18	16	102	2.12	28	191	3.82	50	24	0.48	6	7.60	9.65
June 06, 1979	110	3.10	16	370	7.70	40	512	8.40	44	0	0	0	19.20	17.12
June 10, 1977	100	2.82	18	206	4.29	29	460	7.54	51	0	0	0	14.64	10.41

Note: EPM denotes equivalents per million.

TABLE IV

MAJOR ION CHEMISTRY
BOOTH QUARRY - OW-2-77

CATIONS

Date	Ca			Mg			Na			K			CATION TOTAL	ANION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	136	6.80	56	45	3.70	30	35	1.52	12	7.50	0.19	2	12.22	10.17
June 13, 1983	107	5.35	53	40	3.29	32	33	1.43	14	5.9	0.15	1	10.22	11.07
Nov 16, 1982	129	6.45	63	30	2.47	24	28	1.22	12	4.6	0.12	1	10.26	10.16
June 16, 1982	115	5.74	51	46	3.78	34	34	1.48	13	6.3	0.16	1	11.16	8.05
Oct 13, 1981	97	4.84	47	43	3.54	34	39	1.70	17	7.8	0.20	2	10.28	11.36
June 09, 1981	100	4.99	48	47	3.87	37	32	1.39	13	6.2	0.16	2	10.41	11.13
June 12, 1980	92	4.59	45	44	3.62	36	40	1.74	17	6	0.15	2	10.10	10.97
Nov 21, 1979	98	4.89	46	42	4.03	38	37	1.61	15	8	0.20	2	10.73	10.81
Sept 12, 1979	130	6.48	53	49	4.03	33	34	1.48	12	9	0.23	2	12.23	11.08
June 06, 1979	100	4.99	45	55	4.53	41	34	1.48	13	7	0.18	2	11.17	12.28
Sept 21, 1978	94	4.79	48	45	3.70	37	35	1.52	15	0	0	0	10.01	11.61
May 08, 1978	85	4.24	47	40	3.29	37	30	1.30	15	5	0.13	1	8.96	12.87
Aug 22, 1977	128	6.23	56	27	2.22	20	54	2.35	21	10	0.26	2	11.06	12.28

ANIONS

Date	Cl			SO_4			HCO_3			CO_3			ANION TOTAL	CATION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	20	0.56	6	150	3.13	31	299	5.98	59	25	0.50	5	10.17	12.22
June 13, 1983	31	0.87	8	190	3.96	36	312	6.24	56	0	0	0	11.07	10.22
Nov 16, 1982	24	0.67	7	113	2.35	23	357	7.14	70	0	0	0	10.16	10.26
June 16, 1982	23	0.65	8	104	2.16	27	247	4.94	61	15	0.30	4	8.05	11.16
Oct 13, 1981	28	0.79	7	190	3.96	35	403	6.61	58	0	0	0	11.36	10.28
June 09, 1981	28	0.79	7	192	4.00	36	387	6.34	57	0	0	0	11.13	10.41
June 12, 1980	27	0.76	7	192	4.00	36	379	6.22	57	0	0	0	10.97	10.10
Nov 21, 1979	28	0.79	7	180	3.75	35	383	6.28	58	0	0	0	10.81	10.73
Sept 12, 1979	26	0.73	7	180	3.75	34	403	6.60	60	0	0	0	11.08	12.23
June 06, 1979	26	0.73	6	190	3.95	32	464	7.60	62	0	0	0	12.28	11.17
Sept 21, 1978	26	0.73	6	145	3.02	26	479	7.86	68	0	0	0	11.61	10.01
May 08, 1978	25	0.70	5	210	4.37	34	476	7.80	61	0	0	0	12.87	8.96
Aug 22, 1977	40	1.13	9	217	4.52	37	405	8.64	54	0	0	0	12.28	11.06

Note EPM denotes equivalents per million

TABLE V

MAJOR ION CHEMISTRY
BOOTH QUARRY - OM-6-82

CATIONS

Date	Ca			Mg			Na			K			CATION TOTAL	ANION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	155	7.75	45	48	3.95	23	106	4.61	27	29	0.74	4	17.05	16.03
June 13, 1983	124	6.20	40	45	3.70	23	117	5.09	32	29	0.74	5	15.73	16.77
Nov 16, 1982	120	6.00	37	45	3.70	23	123	5.35	34	35	0.90	6	15.95	16.09
June 16, 1982	127	6.34	39	45	3.70	23	119	5.18	32	46	1.18	7	16.40	14.45

ANIONS

Date	Cl			SO_4			HCO_3			CO_3			ANION TOTAL	CATION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	60	1.69	11	330	6.88	43	348	6.96	43	25	0.50	3	16.03	17.05
June 13, 1983	66	1.86	11	370	7.71	46	359	7.2	43	0	0	0	16.77	15.73
Nov 16, 1982	65.5	1.85	11	333	6.94	43	333	6.7	42	30	0.60	4	16.09	15.95
June 16, 1982	67	1.89	13	350	7.28	50	240	4.8	33	24	0.48	3	14.45	16.40

Note: EPM denotes equivalents per million

TABLE VI

MAJOR ION CHEMISTRY
BOOTH QUARRY - UM-8-77

CATIONS

Date	Ca			Mg			Na			K			CATION TOTAL	ANION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	138	6.90	72	15	1.23	13	31	1.35	14	1.5	0.04	0	9.52	7.95
June 13, 1983	100	5.00	68	13	1.07	15	29	1.26	17	1.5	0.04	0	7.37	7.91
Nov 16, 1982	122	6.10	70	16	1.32	15	30	1.30	15	1.7	0.04	0	8.76	8.66
June 16, 1982	133	6.64	71	14	1.15	12	35	1.52	16	1.4	0.04	0	9.35	7.50
Oct 13, 1981	127	6.34	68	17	1.40	15	34	1.48	16	2.3	0.06	0	9.28	10.29
June 09, 1981	124	6.19	69	15	1.23	14	34	1.48	17	1.6	0.04	0	8.94	9.10
June 12, 1980	112	5.59	65	16	1.28	15	40	1.74	20	2	0.05	1	8.66	9.45
Nov 21, 1979	128	6.38	67	16	1.32	14	41	1.78	19	2	0.06	1	9.54	9.71
Sept 12, 1979	150	7.48	70	15	1.23	12	43	1.87	18	4	0.10	1	10.68	9.30
June 16, 1979	140	6.98	67	18	1.48	14	43	1.87	18	2	0.05	0	10.38	10.80
Sept 21, 1978	118	5.89	68	15	1.23	14	36	1.57	18	0	0	0	8.69	20.05
May 08, 1978	280	13.97	65	15	1.23	6	145	6.30	29	1	0.03	0	21.53	14.15
Aug 22, 1977	180	8.98	56	53	4.36	27	62	2.70	17	5	0.13	1	16.16	13.46

ANIONS

Date	Cl			SO_4			HCO_3			CO_3			ANION TOTAL	CATION TOTAL
	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM	mg/L	EPM	ΣEPM		
Nov 16, 1983	23	0.65	8	100	2.08	26	239	4.78	60	22	0.44	6	7.95	9.52
June 13, 1983	29	0.82	10	105	2.19	28	245	4.90	62	0	0	0	7.91	7.37
Nov 16, 1982	24	0.68	8	94	1.96	23	301	6.02	69	0	0	0	8.66	8.76
June 16, 1982	32	0.90	12	80	1.66	22	230	4.60	61	17	0.34	5	7.50	9.35
Oct 13, 1981	28	0.79	8	120	2.50	27	427	7.00	68	0	0	0	10.29	9.28
June 09, 1981	37	1.04	11	120	2.50	27	339	5.56	61	0	0	0	9.10	8.94
June 12, 1980	34	0.56	10	140	2.91	31	340	5.58	59	0	0	0	9.45	8.66
Nov 21, 1979	35	0.99	10	136	2.83	29	360	5.90	61	0	0	0	9.71	9.54
Sept 12, 1979	35	0.99	11	140	2.91	31	329	5.40	58	0	0	0	9.30	10.68
June 16, 1979	46	1.30	12	130	2.71	25	415	6.80	63	0	0	0	10.80	10.38
Sept 21, 1978	51	1.44	7	538	11.20	56	453	7.42	37	0	0	0	20.05	8.69
May 08, 1978	85	2.39	17	200	4.16	29	464	7.60	54	0	0	0	14.15	21.53
Aug 22, 1977	105	2.96	22	197	4.10	30	390	6.40	48	0	0	0	13.46	16.16

Note: EPM denotes equivalents per million

TABLE VII

SURVEY OF WATER TABLE AT BOOTH QUARRY ASH DISPOSAL SITE JUNE, 1982 TO NOVEMBER, 1983

Observation Well Location	Elevation* of Ground Level (m)	Elevation* of Water Table (m)			
		82 06 21	82 11 05	83 06 08	83 11 09
OW-1-82	103.44	100.81	101.05	101.19	100.91
OW-2-77	102.07	101.36	101.58	101.32	100.85
OW-6-82	101.51	99.08	99.15	99.43	99.31
OW-7-82	101.41	97.00	97.03	97.36	N.D.**
OW-8-77	102.25	100.46	100.55	100.40	100.14
Central Sump	101.46	96.47	96.87	97.56	97.79

* All elevations refer to geodetic datum.
** N.D. denotes not determined - observation well practically dry.

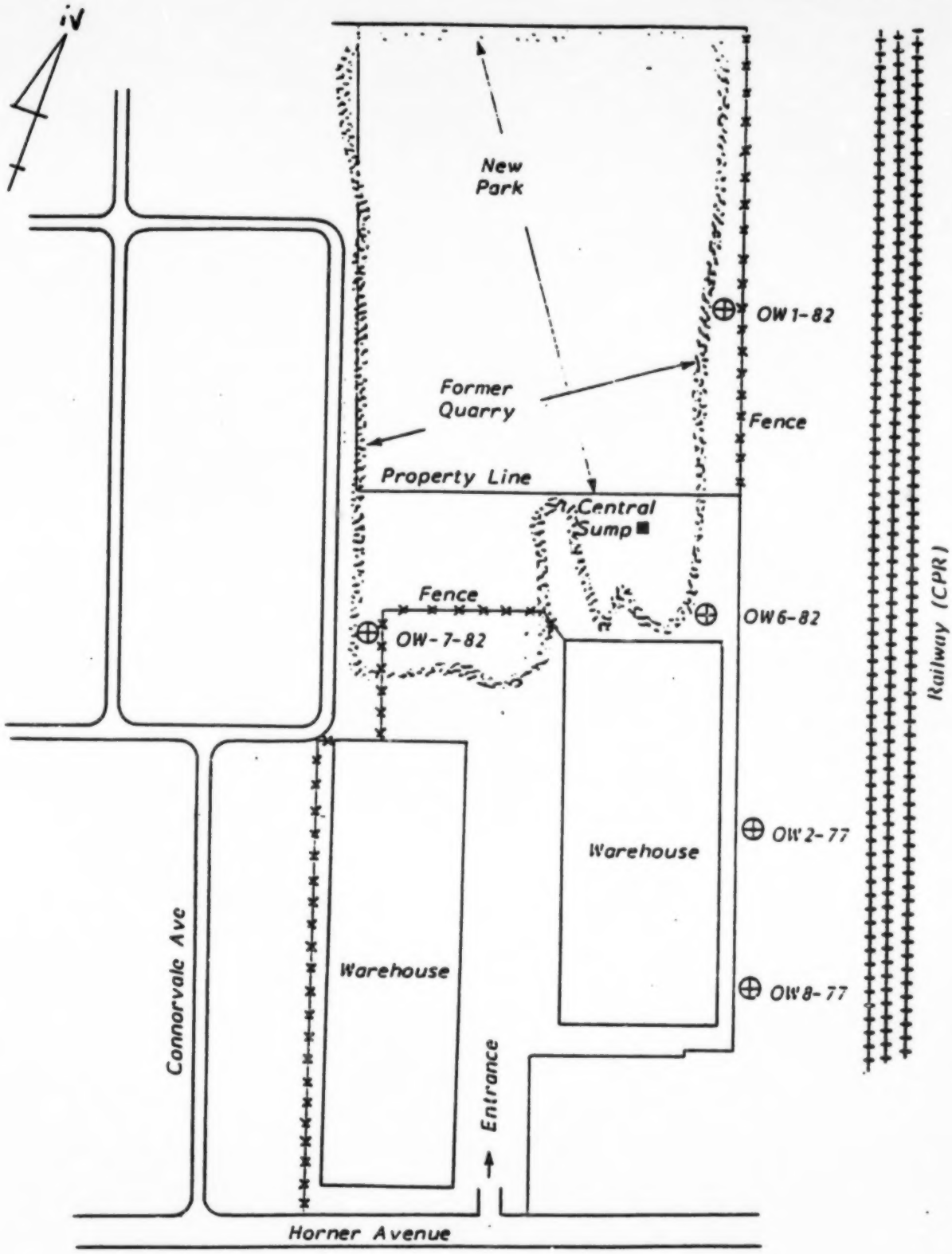

FIGURE 1

BOOTH QUARRY ASH DISPOSAL SITE
(Not to Scale)

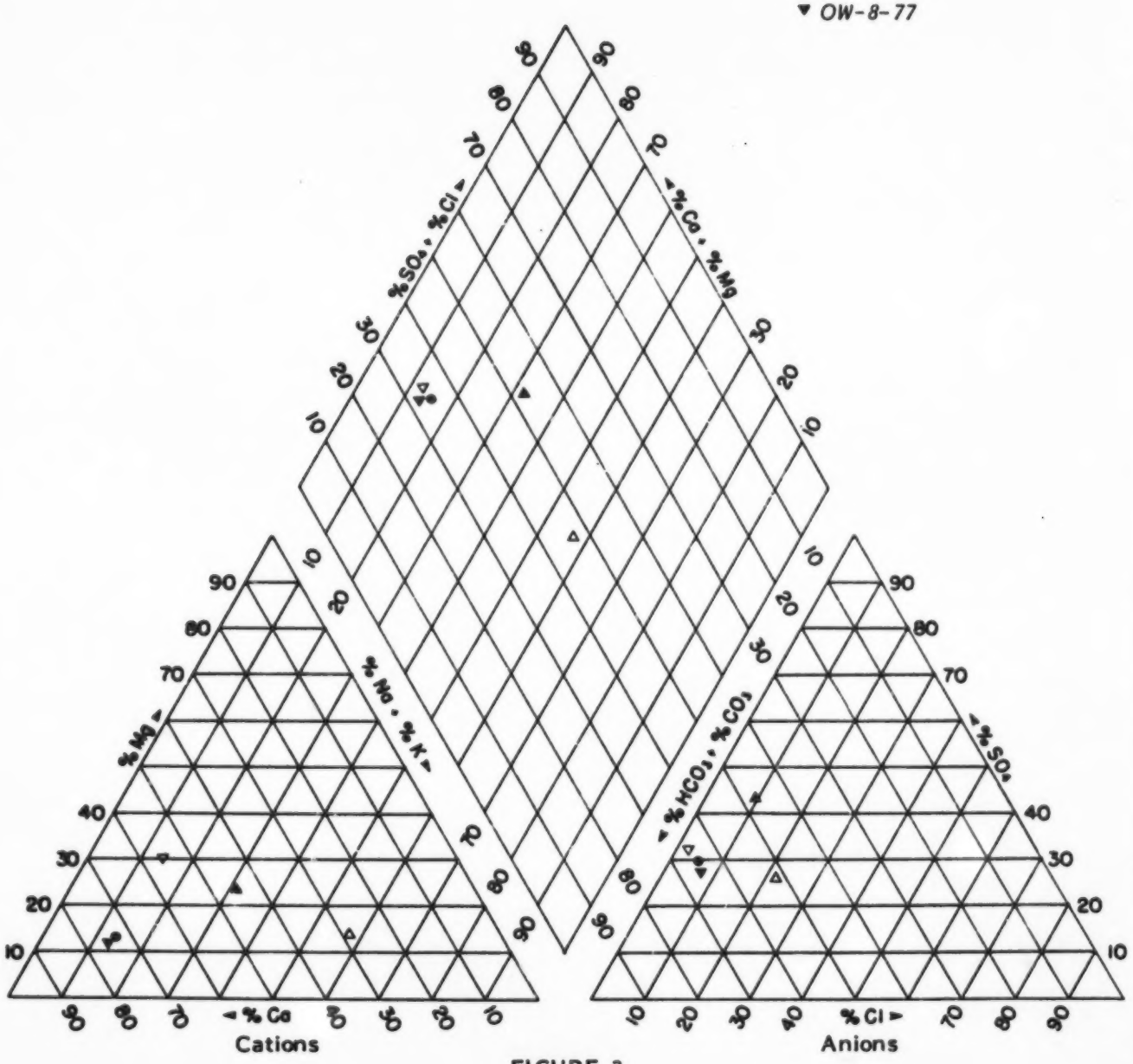

FIGURE 2

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
1983 (NOVEMBER) - ALL LOCATIONS

164625 RD

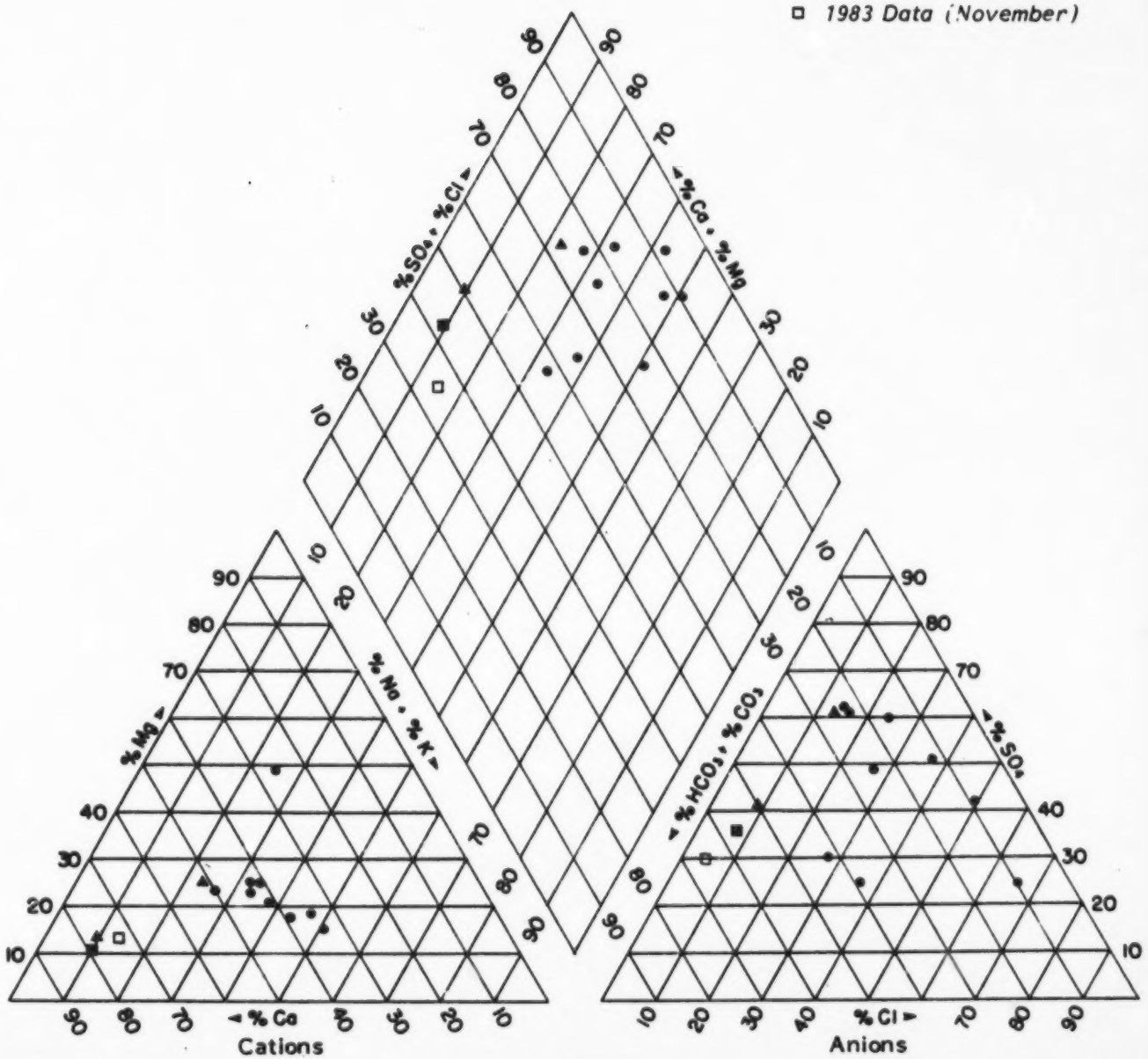

FIGURE 3

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: CENTRAL SUMP

164626 RD

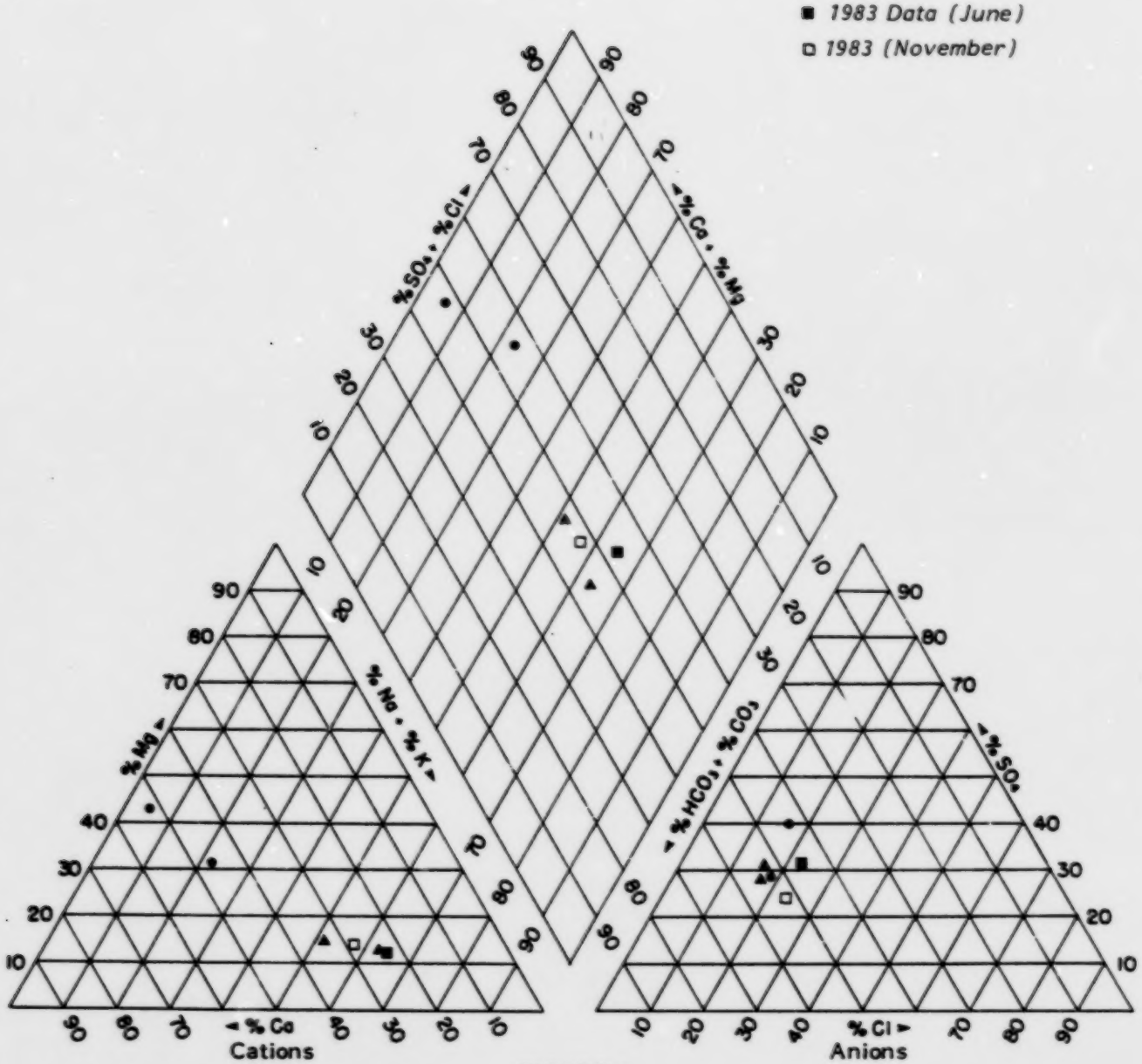

FIGURE 4

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-1-82

164627 RD

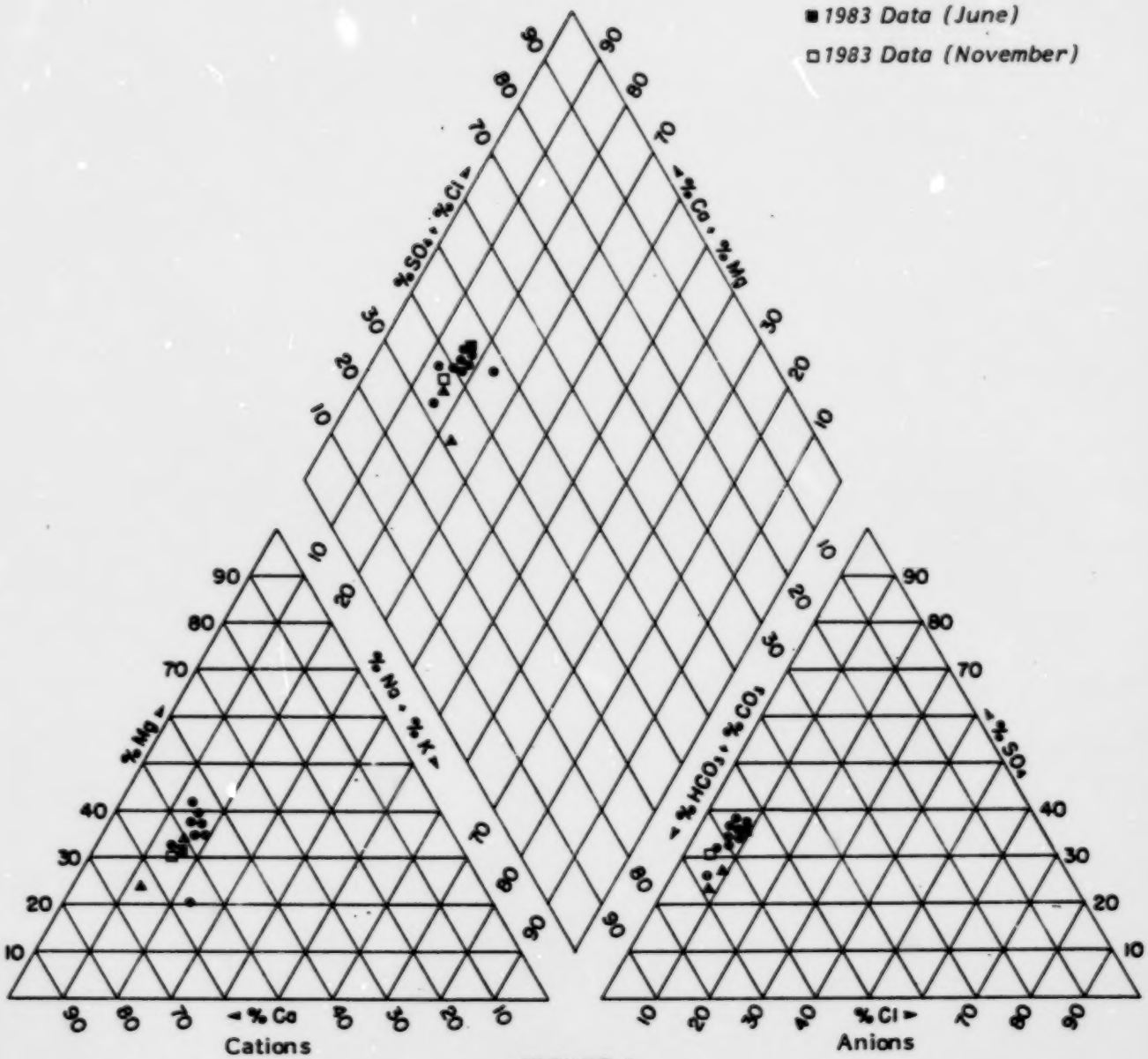

FIGURE 5

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-2-77

164628 RD

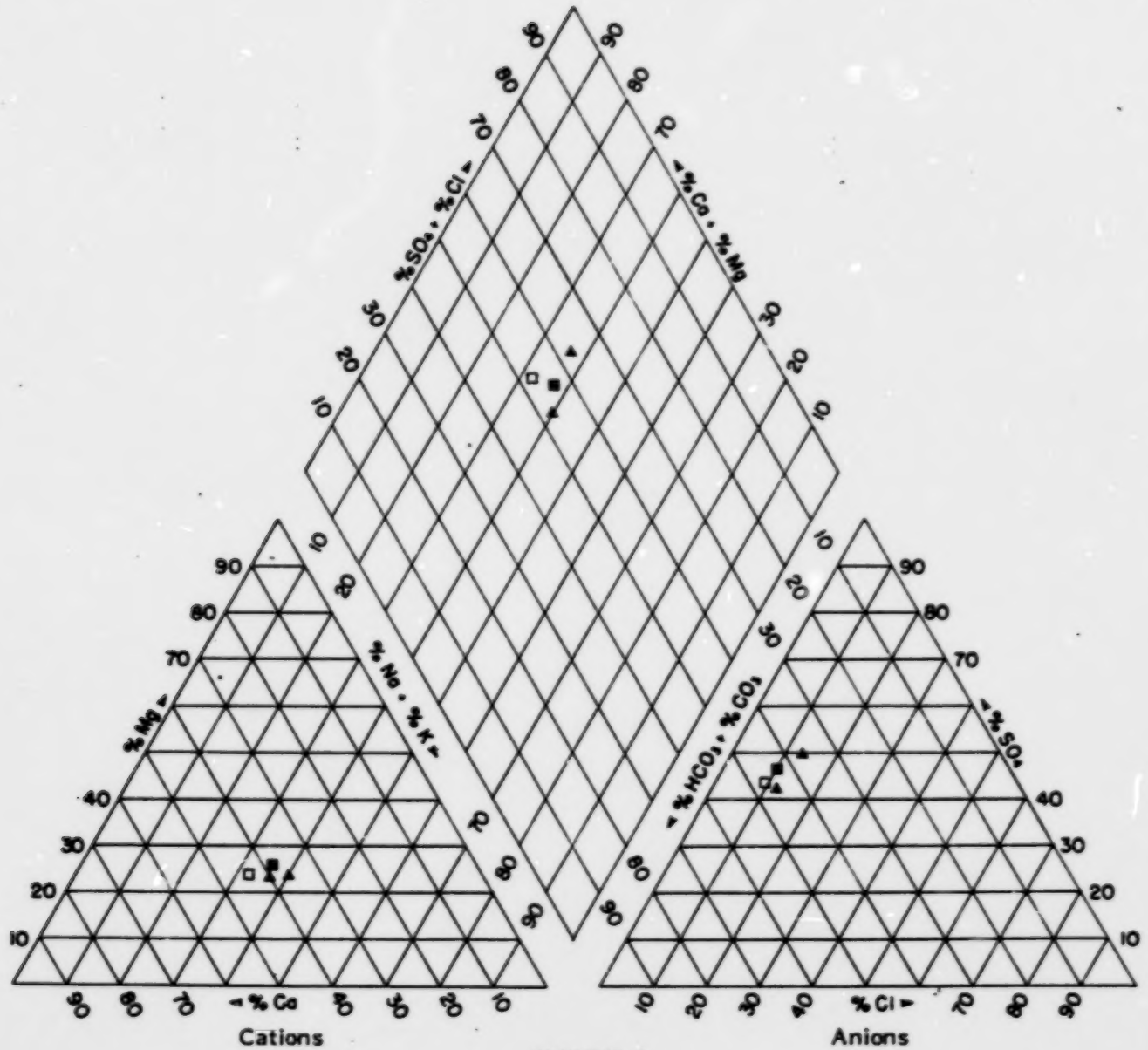

FIGURE 6

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-6-82

164629 RD

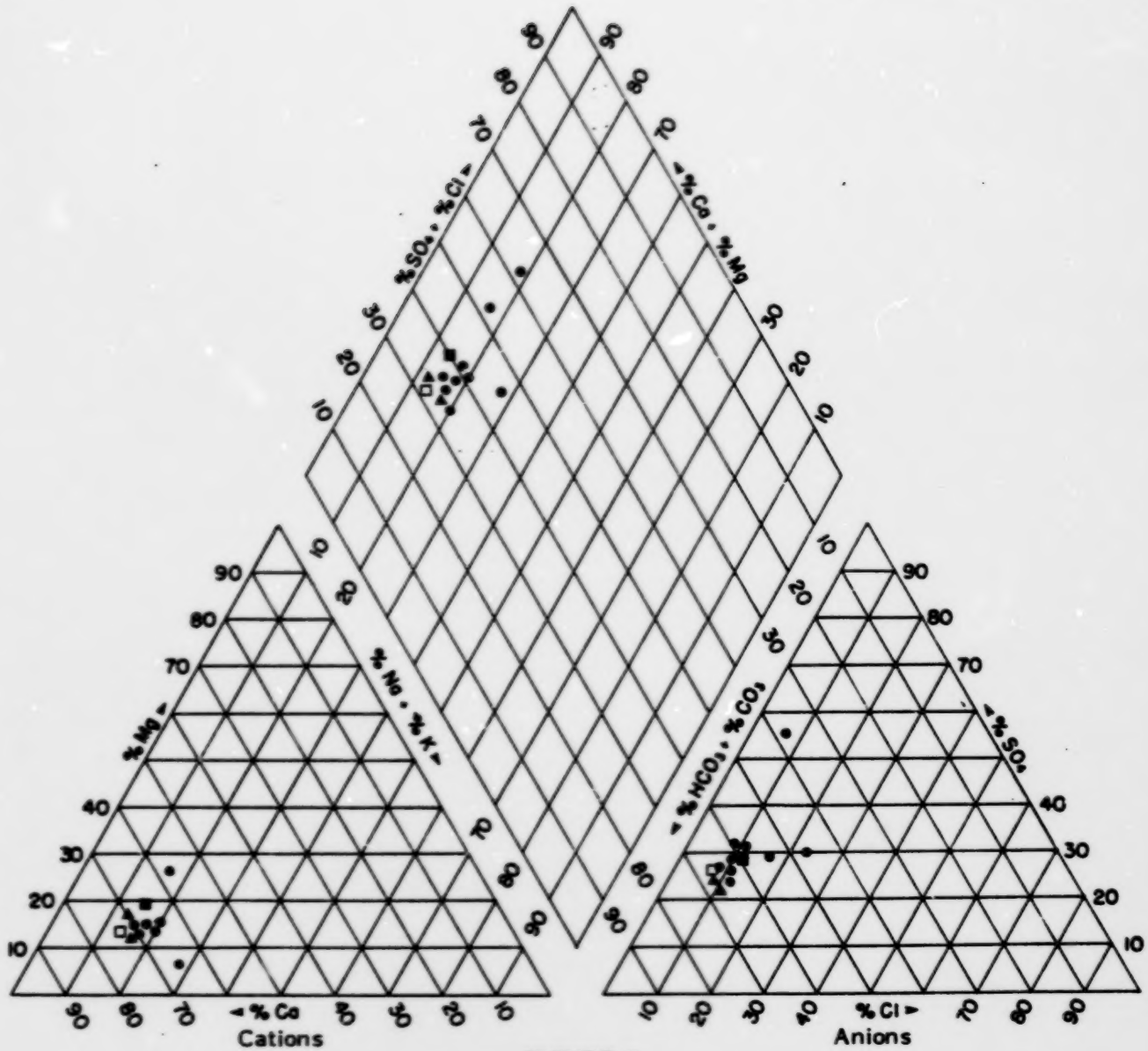

FIGURE 7

BOOTH QUARRY PIPER DIAGRAM
MAJOR ION CHEMISTRY
LOCATION: OW-8-77

164630 RD